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Project Summary

VOC Emission Factors for NAPAP Emission Inventory

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As part of the National Acid Precipitation Assessment Program (NAPAP), the U.S. Environmental Protection Agency (EPA) identified the need to generate emission factors for volatile organic compound (VOC) emissions for a number of source classification categories (SCCs). Each SCC represents a process or function that is logically associated with a point source of air pollution within a given source category. The objective of this effort was to estimate VOC emission factors for categories where substantial amounts of VOC emissions would be expected. In addition to emission factors previously reported, this report includes emission factor estimates developed from a variety of readily available information. Data gathered during numerous standards-setting activities as well as data provided from state emissions inventory data bases were used to calculate the new emission factor estimates. The major emphasis of this effort was on organic chemical manufacturing processes and storage of petroleum products and organic chemicals.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

As part of the NAPAP, EPA's Air and Energy Engineering Research Laboratory (AEERL) updated the October 1985 *NEDS Source Classification Codes and Emission Factor Listing* that was prepared by EPA's Office of Air Quality Planning and Standards (OAQPS). VOC emission factor estimates were generated for SCCs where substantial amounts of VOC emissions would be expected. The major emphasis of this effort was on organic chemical manufacturing process and storage of petroleum products and organic chemicals.

A review of OAQPS's 1985 NEDS document showed that VOC emission factors were needed for about 1,881 of the 3,112 SCCs in the listing. Of the 1,881 SCCs, 32% (605) were in the chemical manufacturing category alone. As a result of the current effort, VOC emission factor estimates were developed for 37% (700) of the SCCs for which VOC emission factors were previously unavailable. Considering the complete listing, emission factor estimates have been provided through this effort for about 22% of all SCCs, leaving about 38% without VOC factors. While relatively large in number, the 1,881 SCCs still lacking VOC emission factor estimates are not major VOC emitters. Table 1 summarizes the VOC emission factor development for the SCC listing in 1985 NEDS document with special focus on chemical manufacturing, petroleum product storage, and organic chemical storage.

The SCCs and emission factors that are reported in OAQPS's 1985 NEDS report resulted from updating all emission factor changes through AP-42, Fourth Edition. The 1985 NEDS report also contains a number of new SCCs and changes to existing SCCs that have been previously listed.

In the current work by AEERL, the primary objective was to provide VOC emission factors for SCCs that had no current listing of VOC emission factors. The major effort was on SCCs with information that was readily available and that would represent a significant quantity

TABLE 1. *SUMMARY OF VOC EMISSION FACTOR DEVELOPMENT*

Category	Total number of SCCs contained in this category	Total number of SCCs previously with VOC emission factors	Total number of SCCs for which VOC emission factors were developed	SCCs with emission factors, %
Chemical manufacturing[a]	691	86	351	63
Volatile organic liquid storage[b]	433	76	191	62
Other	1,988	1,069	158	62
Total[c]	3,112	1,231	700	62

[a] *Includes organic and inorganic chemical manufacturing processes.*
[b] *Fixed- and floating-roof storage tanks.*
[c] *OAQPS's 1985 NEDS document contains 3,112 SCCs of which 1,881 were previously without VOC emission factors. VOC emission factors have now been developed for 700 of these SCCs. Many of the remaining categories are not major VOC emitters.*

of VOC emissions to the atmosphere. The new emission factors resulting from this current work are not of the same quality as emission factors tabulated in AP-42. They were generated from sparse data on units in the synthetic organic chemical manufacturing industry (SOCMI) and from emission factor estimates provided by individual air quality districts within states. In terms of the AP-42 ratings, the estimates provided from this effort would be considered of "E" quality.

A survey of the SCC and emission factor listing given in OAQPS's 1985 NEDS document found that little data were presented for organic chemical manufacturing and storage of petroleum products and organic chemicals. These SCCs, therefore, were targeted as the highest priority in evaluating new emission factors. Lower priority was assigned to categories where little or no VOC emissions were expected; e.g., inorganic chemical manufacturing and smelting/metal producing operations.

Chemical Manufacturing

Approximately 105 chemical manufacturing processes are given in the 691 SCC listings for the chemical industry. For each process, individual unit operations are identified by individual SCCs as having the potential to emit VOC directly to the atmosphere. Approximately 57% of these chemical manufacturing processes comprising 605 SCCs required emission factor estimates. A total of 351 new emission factor estimates were generated, with most focused on air oxidation processes, plastics manufacturing, and solvents operations.

The new emission factors provided in the report were generated from data gathered during numerous standards-setting activities and from data provided from State emissions inventory data bases. Dockets for new source performance standards (NSPS) for fugitive emissions, air oxidation processes, distillation operations, and reactor processes within SOCMI were valuable sources of VOC emissions data. These dockets contain background information, reference material, and industry responses to Clean Air Act Section 114 letters pertaining to the development of the NSPS. In addition, two industry-wide studies conducted in the 1970s were reviewed to gather additional VOC emissions data where information was not available from the standards development files. Even though this information may be incomplete in terms of all SCC listings, many of chemical manufacturing processes were provided with some emission factor estimates. Sufficient industry information was available from these studies to calculate VOC emission factor estimates for about 46% of the 105 chemical manufacturing processes in OAQPS's 1985 NEDS document. A number of source-specific documents were used to supplement the information gathered for VOC emission factors, including Background Information Documents (BIDs), Source Assessments, and chemical-specific emission source survey documents.

Finally, six states (California, Texas, Louisiana, Illinois, New Jersey, and West Virginia) were contacted to gather information on VOC emissions. Since a large portion of the organic chemical manufacturing industry is located in these states, they potentially have the highest rate of process-related VOC emissions. Most states contacted did not have emissions data in a readily available form (either not in computer files, in confidential files, or unverified). However, some current emission factor data were made available for inclusion in this report.

Volatile Organic Liquids Storage

Storage of petroleum products and organic chemicals was the second area of special interest for developing emission factor estimates. A total of 191 new emission factors were estimated for storage of petroleum products and organic liquids. Of this total, 88% were for emissions from fixed- and floating-roof tanks containing organic liquids.

Equations for estimating VOC losses from storage tanks have been recently revised by the American Petroleum Institute (API). These revised equations are included in the latest edition of Section 4-3 of AP-42 (September 1985). Tank dimensional data for model tanks and assumptions on average atmospheric conditions were repeated from AP-42, Third Edition. Physical properties of organic compounds were extracted from published chemical abstracts. Using the revised equations, breathing loss and working loss emission factor estimates were calculated for both fixed- and floating-roof tanks for 89 chemicals. Emissions data from state emission inventory files were also used to complete emission factor estimates for storage losses. New VOC emission factor estimates have been added for about 44% of the SCCs concerning storage of petroleum products and organic chemicals.

Other Categories

Even though this effort focused on the chemical industry and storage of volatile organic liquids, emission factor estimates were provided for 158 SCCs outside of these two areas. Put into perspective, estimates were generated for about 17% of all other categories previously without emission factors. The estimates provided were based on readily available EPA literature on vegetable oil processing, plastics products, fiberglass reinforced products, and metals-oriented operations, the last covering foundries and smelters (copper, lead, zinc). In many cases, emission factor estimates for smelting operations have been listed as negligible with emissions resulting from uncombusted fuel. Similarly, VOC emis-

sions from process heaters in various industry groups have been tabulated as negligible.

Recommendations

Recommendations for further study to develop new VOC emission factors and refine existing emission factors are included in the report. Proposed activities for further study include visiting states where emissions inventory data are available and conducting a more in-depth literature search for quantitative data on source categories where VOC emissions are considered small. Additional computational techniques can also be applied to estimate emission factors for storage of organic chemicals and petroleum products.

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The complete report, entitled "VOC Emission Factors for NAPAP Emission Inventory," (Order No. PB 87-141 040/AS; Cost: $18.95, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
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